

REMARKS

Claims 1, 2, 14 and 20 are amended. Claims 6 and 21 are cancelled. Claims 1-5, 7-20 and 22-26 are pending in the application.

Claims 1-26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kwag, U.S. Patent No. 6,232,228, or as being unpatentable over Kwag in view of Donnelly, U.S. Patent No. 6,143,658. The Examiner is reminded by direction to MPEP § 2143 that a proper obviousness rejection has the following three requirements: 1) there must be some suggestion or motivation to modify or combine reference teachings; 2) there must be a reasonable expectation of success; and 3) the combined references must teach or suggest all of the claim limitations. Pending claims 1-5, 7-20 and 22-26 are allowable over Kwag and Donnelly for at least the reason that the references fail to disclose or suggest each and every limitation in any of those claims.

As amended, independent claim 1 recites forming a metallic copper-containing material, forming contaminant particles on a surface of the metallic material, and exposing the surface to a mixture comprising Cl⁻, NO₃⁻ and F⁻ to selectively remove the contaminating particles from the surface. The amendment to claim 1 incorporates the subject matter of claim 6 and is further supported by the specification at, for example, page 10, line 13 through page 11, line 13. Kwag discloses etching a conductive layer utilizing an etching composition comprising HNO₃ and HF which is specifically designed to etch the conductive layer to remove a thickness of from 40-95% of the layer (col. 4, ll. 10-20; col. 4, ll. 63 through col. 5, ll. 11; col. 6, ll. 37-40 and col. 12, ll. 33-42). Kwag additionally indicates that the disclosed etching compositions can be utilized to planarize a dielectric material (col. 5, ll. 12-26). Kwag does not disclose or suggest the claim 1 recited forming

contaminant particles on a surface of a metallic material and exposing the surface to a mixture comprising Cl⁻, NO₃⁻ and F⁻ to selectively remove contaminating particles from the surface.

Donnelly discloses removal of contaminants utilizing an oxygen plasma and indicates subsequent exposure to dilute hydrofluoric acid (col. 6, ll. 6-18). As combined with Kwag, the removal of contaminants from a copper surface utilizing oxygen plasma and subsequent emersion in dilute hydrofluoric acid as disclosed by Donnelly does not contribute toward suggesting the claim 1 recited selective removal of contaminating particles from a surface of a copper-containing metallic material by exposing to an acidic mixture of Cl⁻, NO₃⁻ and F⁻. Accordingly, independent claim 1 is not rendered obvious by the combination of Kwag and Donnelly and is allowable over these references.

Dependent claim 2 is amended to properly depend from claim 1. Claim 6 is cancelled. Dependent claims 2-5 and 7 are allowable over the combination of Kwag and Donnelly for at least the reason that they depend from allowable base claim 1.

Independent claim 8 recites exposing a surface of a copper-containing material to a cleaning solution formed from hydrochloric acid, nitric acid and hydrofluoric acid where the exposing removes less than 5 Angstroms of a second material over the copper-containing material. As discussed above, Kwag discloses compositions utilized for etching a conductive material or planarizing a dielectric material. The specific indication in the Kwag disclosure that the compositions are utilized to planarize or etch to remove predetermined amounts of between 40% and 95% of a material does not suggest the recited removing of less than 5 Angstroms from sidewalls of an opening. Further, the Kwag disclosure does not provide a reasonable expectation of achieving the removal of less than 5 Angstroms

from the sidewalls of an opening. As combined with Kwag, the Donnelly disclosure of utilizing oxygen plasma followed by dilute hydrofluoric acid treatment does not contribute toward suggesting the recited exposing to a mixture of hydrochloric, nitric and hydrofluoric acid which removes less than 5 Angstroms of a second material from sidewalls of an opening. Accordingly, independent claim 8 is not rendered obvious by the combination of Donnelly and Kwag and is allowable over these references.

Dependent claims 9-13 are allowable for at least the reason that they depend from allowable base claim 8.

As amended, independent claim 14 recites cleaning a base surface of an opening with an acidic mixture comprising Cl^- , NO_3^- and F^- to remove contaminating particles from a base surface where the cleaning removes contaminating particles without changing the configuration of the sidewalls. The amendment to claim 14 is supported by the specification at, for example page 10, line 13 through page 11, line 13. Independent claim 14 is allowable over the combination of Donnelly and Kwag for at least reasons similar to those discussed above with respect to independent claims 1 and 8.

Dependent claims 15-19 are allowable over the combination of Donnelly and Kwag for at least the reasons that they depend from allowable base claim 14.

As amended, independent claim 20 recites an opening to a copper-containing substrate where the opening has sidewalls comprising silicon oxide and silicon nitride, and has an interface between the silicon oxide and the silicon nitride. Claim 20 further recites cleaning the base surface of the opening with a solution formed from hydrochloric, nitric and hydrofluoric acids, where the cleaning removes less than 5 Angstroms of silicon oxide from the sidewalls without formation of a divot at the silicon oxide/silicon nitride interface.

The amendment to claim 20 is supported by the specification at, for example, page 10, line 13, through page 11, line 19. Claim 20 is allowable over the combination of Donnelly and Kwag for at least reasons similar to those discussed above with respect to independent claim 8.

Dependent claim 21 is cancelled. Dependent claims 22-26 are allowable over Donnelly and Kwag for at least the reason that they depend from allowable base claim 20.

For the reasons discussed above, pending claims 1-5, 7-20 and 22-26 are allowable. Accordingly, applicant respectfully requests formal allowance of such pending claims in the Examiner's next action.

Respectfully submitted,

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